CONTRIBUTION TO OUR KNOWLEDGE OF AUSTRALIAN *HIRUDINEA*.

Part i.

By E. J. Goddard, B.A., B.Sc., Junior Demonstrator in Biology, Sydney University.

Introduction.—The freshwater Rhynchobdellidæ of New South Wales, in fact the Hirudinea of Australia generally, have so far been neglected. Although search proves that the Hirudinea are well represented in Australia, the only account of any of these for a number of years is that given by Miss Lambert in connection with the Land Leech *Philæmon pungens* in 1897. The small size of the animals and their conditions of life no doubt in some way account for the neglect which they have suffered, inasmuch as they would not be readily recognised as "Leeches" by any one not interested in our freshwater fauna, and hence they would not enjoy the prominence bestowed on the common Leech, *Hirudo quinquestriata*.

The field is sufficiently fruitful to warrant successful investigations.

The present paper deals with some Leeches belonging to the family *Glossiphoniidæ*, two species being members of the type genus, *Glossiphonia* (syn. *Clepsine*), the third specimen described constituting a new genus.

As the group is a very interesting one from several standpoints, I resolved, in taking advantage of Dr. Hill's kindness in giving me some fine specimens which he had collected, to attempt some work on the group.

I would here express my great indebtedness to Professor Haswell for placing at my disposal any literature which he possessed, and for his kind encouragement in every way.

I would also take this opportunity of expressing my thanks to Dr. Hill for his kindness in placing the specimens at my disposal.

Methods.—Corrosive sublimate proved an excellent fixative with these specimens, and I find that Castle advises the use of that reagent in fixing Glossiphonids. Specimens fixed in Zenker's fluid show a certain amount of distortion as regards the cellular elements. Entire specimens cleared in cedar oil gave me much help preliminarily in the study of the gross anatomy of the digestive system.

Castle* recommends iron-hæmatoxylin as the best stain for sections; and I found sections so stained to outclass those stained with other reagents. The strongly developed musculature offers good material for a counter stain with eosin.

The specimens were imbedded in paraffin by the benzole method after having been cleared in cedar oil, and good results were thus obtained.

The genus *Glossiphonia* (*Clepsine*) is well represented as regards species in North America and Europe, where much work and attention have been given to them by Whitman, Castle, Apathy, Grube, Mueller, Oka and others.

In 1900 Dendy and Olliver described what was regarded as a biannulate species of *Glossiphonia* from New Zealand, but later it was found to be a species of *Microbdella* Moore.

The species of *Glossiphonia* described in this paper constitute, I believe, the first record of the genus from Australia. Lately I have obtained other species from Tasmania and the mainland, so that the species is a really very widely distributed form.

Glossiphonia is characterised among the Glossiphonid Rhynchobdellidæ by the triannulate nature of the somite and broad flat body which is rolled into a ball when disturbed after the

* Bull. Mus. of Comp. Zool. Harvard Coll. Vol.xxxvi. p.18.

fashion of Oniscus. The young are carried about attached to the concave ventral surface of the adult, this surface acting as a marsupium or brood pouch. The individuals occur in ponds and slowly moving fresh water, under stones, beneath the bark of submerged and floating timber, and parasitic on molluscs, etc.

Glossiphonia australiensis, sp.nov.

This species was obtained by Dr. Hill in a creek near Oberon, N. S.W. The species is of much interest from a phylogenetic standpoint, and well deserves a specific name indicative of its locality of occurrence.

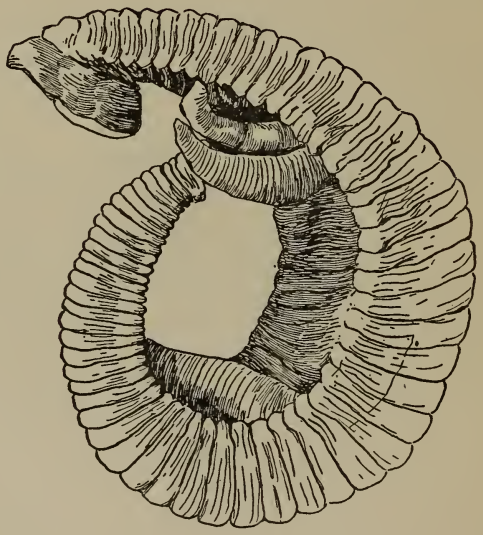

Fig. 1.—*Glossiphonia australiensis*, sp.n.

Internal view showing three young ones attached to the concave ventral surface. The number of annuli can be easily made out, and the anus seen between the ultimate and penultimate rings. Note also the roughness of the surface. (Drawn from a photograph).

External characters.—The body resembles in its general form that of most other species of the genus. It is broadest about the

middle of its length, tapering towards the anterior and posterior ends. The anterior extremity is slightly wider than the "neck" in the preserved specimens, but this may be due to contraction.

The length of adult individuals when fully extended is about 15 mm.; in a state of contraction about 10 mm. The width in the middle region of the body is about 5 mm.

The body in a state of contraction is concavo-convex in section. The surface is rough and devoid of papillæ when viewed macroscopically. In section, however, the skin is seen to be covered by a large number of papillæ due to outpushings of the cuticle with the underlying epidermis and subepidermis.

I am not in a position to say whether these papillæ are innervated or not, or whether they are of any segmental significance in connection with somite-limits.

Unfortunately as I have been unable to procure living specimens I cannot make any detailed remarks concerning the colour and pattern-ornamentation of the species. The preserved specimens were of a flesh colour, and Dr. Hill informed me that they differed in no way from the living specimens as regards colouration. The body is quite opaque, and this feature prevented me in the first place from regarding the species as *Glossiphonia heteroclita*, which it closely resembles in other features, unique among which is that of closely approximated genital apertures which in *G. heteroclita* are said to be actually united.

The annuli are distinct and well marked off from one another. The total number is seventy, sixty-three of them lying behind the anterior sucker. The annuli are of greatest extent in the middle region of the body, gradually diminishing in size as they approach the anterior and posterior regions of the body.

As in all species of *Glossiphonia*, the total number of somites is thirty-four. This I have determined in the species under description by making a count of the number of nerve-capsules The first, second, and third somites are uniannulate, the fourth biannulate, and most of the others triannulate.

Eyes six in number; the first pair, which are situated on the second annulus, being much smaller and closer together than the

second and third pairs. The second and third pairs of eyes are situated on the third and fourth annuli respectively. They are large in size and the members of each pair widely separated. The second and third eyes on each side are closely approximated. The anterior pair are directed forwards and toward the side of the body; the second pair toward the side and slightly backward; the posterior towards the posterior region of the body.

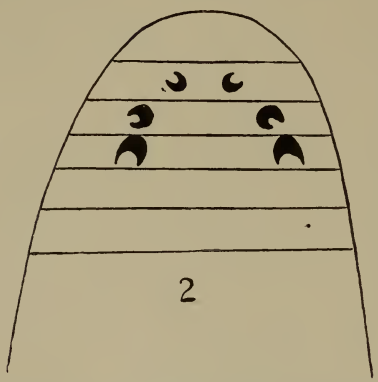

Fig. 2.—*Glossiphonia australiensis*, sp.n. Anterior end, showing the position of the eyes.

The anterior sucker is constituted by seven annuli. The anus is situated on the dorsal surface between the penultimate and ultimate annuli.

Genital apertures.—When first examining the species I was inclined to regard the genital apertures as united. This condition obtains in *Glossiphonia heteroclita*, which is unique in that respect among species of *Glossiphonia*. On making a closer examination with the aid of sections, I found that the apertures were distinct but separated by a single annulus—the twenty-ninth—which is much diminished in importance. The two apertures open into a depression with tumid lips which lies behind a small clitellum-like swelling on the ventral surface, between the twenty-eighth and thirtieth annuli. Probably one would be enabled to see these separate apertures if an examination were made of a perfectly extended organism.

The male aperture, then, lies between the twenty-eighth and twenty-ninth annuli, the female aperture between the twenty-ninth and thirtieth. From a study of transverse sections one might readily fall into the error of describing the genital apertures as united, to such an extent has the twenty-ninth annulus been diminished on the ventral surface.

In describing the position of the genital apertures in *Glossiphonia heteroclita*, Blanchard says, "Porus genitalis masculus inter annulos 25-26, vulva inter annulos 27-28 hians."

Castle, in his carefully written account of the Fresh Water Rhynchobdellidæ of North America, says "Blanchard is certainly in error in his description of the position of the genital apertures," and points out that there is a single united aperture situated between the twenty-eighth and twenty-ninth annuli.

Body-wall and body-substance.—Much has been written on this subject. Bourne has given an excellent description in a comparative way of the important genera of the Hirudinea. I do not hope to add any great amount of information to Bourne's account, but intend to furnish some notes of specific character which may be of some use in connection with that already published.

The body-wall consists of five layers—cuticle, epidermis, dermis, circular muscle fibres, longitudinal muscle fibres.

The cuticle calls for no special remark beyond that it is produced into a great number of microscopic papillæ into which rise corresponding projections of the epidermis and dermis. No nerve connections could be made out, but they possibly may have some tactile or sensory function, or again may be due to the state of contraction of the organism.

The epidermis consists of a single layer of columnar cells with a fairly large nucleus. Some of the cells are enormously enlarged to form large pear-shaped glands which are sunken to a great depth from the main epidermal layer so as to lie on the external surface of the circular muscle mass which lies beneath the dermis and imbedded in the dermis. The glands contain a finely granular substance which, like the glandular cells themselves, takes an intense stain with hæmatoxylin. The glands are much more abundant in connection with the dorsal than with the ventral surfaces. In the dorsal and the latero-ventral regions one makes out clearly two distinct tiers of epidermal glands, one tier being deeply seated, the other more superficially situated and consisting of much smaller elements

than the former. In the region of the clitellar swelling, which lies in front of the genital apertures, the glands are absent, and we find the same condition for some distance on either side of this swelling.

The dermis is of considerable thickness, and consists of a matrix in which occur numerous cells with a large nucleus, and also diagonal muscle fibres. These fibres are, according to Bourne, absent in the species which he examined. The cells mentioned above as occurring in the matrix constitute the "excretophores" of other species of *Glossiphonia*.

The circular muscle fibres form a layer equal in thickness to the combined epidermis and dermis.

The longitudinal muscle fibres are arranged in masses beneath the circular fibres, the groups being separated from each other by dorsi-ventrally directed fibres. These longitudinal fibres show very distinctly, in their cortical position, the striations seen in the other members of the Hirudinea.

The body-substance consists of a vacuolated mass, scattered in which are the complex series of sinuses, various kinds of corpuscular cells, and the salivary glands.

The salivary glands far exceed in size any other cellular elements in the body, with the exception of the ova. In sections they appear as chains of large oval or spherical cells deeply stained. They extend in each side of the body from the anterior limits of the ventral nerve cord to the posterior extremity of the ovaries, and thus form very conspicuous elements.

Fat cells are abundantly distributed through the body, inasmuch as abundant cellular elements occur containing a nucleus and very scant cytoplasm.

Graf has attributed to the "excretophores" an excretory function, thinking that they take up excretory products in the deeper portions of the body and then travel towards the surface of the body and disintegrate. With this belief I am in accord. The great abundance of these cells and the great diminution in the development of the nephridia in *Glossiphonia australiensis* incline me to think that the "excretophores" have the function

of excretion dependent upon them. They occur abundantly in close connection with the blood sinuses, which perhaps is of further significance.

Connecting the ventral and dorsal body walls are masses of dorsi-ventral muscle fibres. In the posterior region behind the stomach these muscles are more obliquely arranged, and constitute the bulk of the body substance.

One can differentiate between a group which runs on either side of the pharynx, and others more laterally situated. Those situated on either side of the pharynx in places form the lateral boundaries of the ventral lacuna; in other regions they divide that lacuna into median and lateral divisions. In effecting this division they do not form continuous sheets, but occur as bundles, an arrangement which may be of metameric significance.

Sinuses and coelome.—Possibly no Leech presents more interest than *Glossiphonia* in the study of the coelome and its remains. That the sinuses represent the remains of a coelome, is prettily borne out by the occurrence in these channels of large nucleated cells which in every probability represent the remains of a coelomic epithelium, as pointed out by Bourne. These elements do not occur in the vessels, and thus additional weight is given to this argument.

The details of the system of sinuses agree very closely with those of other species, and call for no special remark, owing to Oka's work in that connection.

Digestive canal.—The mouth is situated in the anterior portion of the oral sucker, and lies in the third somite of the body, which is the position most common in other species. The mouth leads dorsally into the pharyngeal sac. The wall of this sac is folded and its lumen circular in cross-section. The anterior region of the sac runs from the mouth to the central portion of the central portion of the body-substance, and thence extends backward through the brain-mass.

The proboscis lies within the pharyngeal sac, and extends through the greater part of its extent, occupying the area of about twenty annuli. The posterior region of the proboscis

becomes attached to the wall of the pharyngeal sac which surrounds the whole of the proboscis except a small part at the posterior extremity, occupying about two annuli.

The wall of the pharyngeal sac consists of a layer of flattened epithelial cells which are found to be continuous with the epidermis of the body. It is quite devoid of the glandular elements which occur as modified epidermal cells in the body-wall.

The wall of the proboscis comprises five distinct elements :—

(1) *Pharyngeal epithelium*, consisting of a single layer of minute flattened cells.

(2) *Radial muscles*, occupying a great portion of the pharyngeal wall which passes out between the circular muscle elements, and then becoming dilated to abut on the epithelium of the external surface of the proboscis.

(3) *Circular muscles*, forming three crescentic masses lying, together with the radial muscles, in the triangular areas formed by the contour of the inner wall of the proboscis.

(4) *Longitudinal muscles*, occurring as bundles scattered among the outer portions of the radial muscles, which occupy the greater part of the region in which the longitudinal muscles occur.

(5) *External epithelium*, consisting of flattened cells, continuous at the posterior end of the pharyngeal sac with its wall, and so representing portion of a modified epidermis.

The proboscis leads posteriorly into the œsophagus. When the proboscis is retracted, the œsophagus appears as a tube running parallel and dorsally to it, and extending through about eleven annuli. Its wall is very much folded, and quite different in character from that of the proboscis and crop. The internal lining layer consists of cells which take a vivid blue stain with hæmatoxylin. This layer is very much folded, reminding one of the general appearance of the pharyngeal sac when the proboscis is retracted. The folding of the layer is due to the contraction of the œsophageal muscles when the proboscis is withdrawn. The muscles of the wall of this portion of the digestive system consist of circular muscle fibres immediately external to the

lining epithelium, and an outer mass of longitudinal muscle fibres. The main differences in the constitution of the walls of the proboscis and œsophagus are—(1) There is an abundant radial musculature in the wall of the proboscis. (2) The longitudinal muscle fibres are arranged less compactly in the proboscis than in the œsophagus. (3) The lining epithelium of the proboscis is less definitely developed than in the case of the œsophagus.

The crop is a thin-walled sac extending backwards from the œsophagus as far as the fiftieth annulus. It lies close to the dorsal body-wall owing to the enormously developed ventral median lacuna in this region. It gives origin to six pairs of diverticula, as is the case in *Glossiphonia heteroclita*. In the young individuals found attached to the adult and evidently about to become free, only five such diverticula are present, the sixth pair being developed later anterior to these five. This last-developed pair of diverticula is quite permanent in character, and not merely due to a temporary dilatation of the crop, as is found to be the case in some species. Each cæcum is connected with the crop by a slender passage in the adult, but in young individuals no well marked connecting passage can be discerned, as distinct

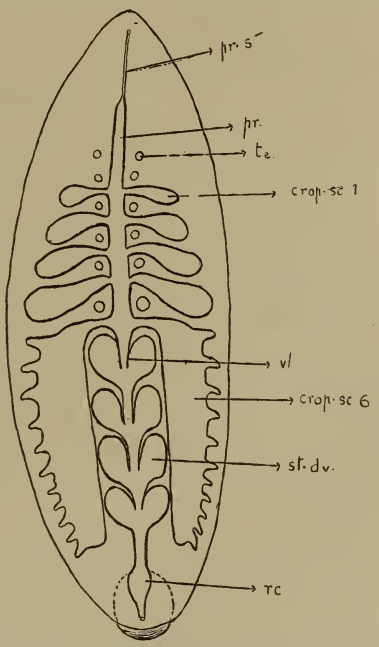

Fig.3—*Glossiphonia australiensis*, sp.n.*

* Fig.3.—*Glossiphonia australiensis*, sp.n. Young individual showing the digestive system, and the position of the six pairs of testes.
pr.s., proboscis sac—*pr.*, proboscis—*te.*, testis—*crop sc. 1*, second pair of crop cæca of adult—*vl.*, valve between crop and stomach—*crop sc. 6*, last pair of crop cæca—*st. dv.*, stomach diverticulum—*rc.*, rectum.

from the main portion of the pouch. The cæca are directed towards the ventro-lateral region of the body. They increase in size and importance as they approach the posterior end of the body, the smallest pair being most anterior, the largest most posterior. The first five pairs are simple in outline, but the sixth pair gives rise to a great number of secondary cæca, and extend on either side of the stomach from the forty-fourth to the sixtieth annuli. The walls of the crop and cæca consist of a lining epithelium of large columnar cells, with conspicuous spherical nuclei, and an external inconspicuous layer of circular muscle fibres. The structure of the wall is such as would best serve the crop and cæca in the function of storing food material. The longitudinal muscles, so strongly developed in connection with the œsophagus, are not represented in the crop and cæca.

The stomach gives off four pairs of diverticula which are auricular in shape and not elongate as in *Glossiphonia heteroclita*. The contents of the stomach are quite different from those of the crop. Whereas, in the crop, there is present a mass of muscle material, etc., obtained by the carnivorous character of the species, in the stomach there is found a clear mass as the result of digestive changes. The passage of the material from the crop to the stomach is regulated by a valve-like structure situated at the junction of the crop and stomach. The portion of the crop lying behind the point of origin of the last pair of cæca becomes intimately connected with the antero-mesial wall of the first pair of stomach diverticula; and this portion of the united common wall of the stomach and intestine projects into the cavity of the stomach, preventing material from passing forwards from the stomach to the crop, and, at the same time, regulating the passage of food from the crop to the stomach.

The rectum is a pear-shaped chamber opening to the exterior at the anus, which is situated between the sixty-ninth and seventieth annuli.

The epithelial lining of the stomach takes a very deep stain with hæmatoxylin. The cells of this layer are tall and columnar, with a spherical centrally situated nucleus.

Surrounding the diverticula of the stomach and so lying between them and the last pair of crop cæca, is a very strongly developed series of blood-channels. This great development, together with the ultimate connection of the channels with the stomach epithelium, points to the stomach as being functional both in digestion and absorption.

The wall of the intestine consists of a much folded epithelium of columnar cells, external to which are circularly arranged muscle-fibres. The blood-channels previously mentioned in connection with the stomach are not present in the immediate neighbourhood of the intestine, and so probably the rectum is connected solely with the function of egestion.

Reproductive organs.—The species is protandrous. In examining sections of young individuals which were attached to an adult, it was found that mature testes were present but ova were not. In the case of one adult specimen which had a number of young individuals attached to its ventral surface, it was found that the testes were mature, the organ appearing as a hollow chamber in which sperm groups were abundant. No ova were present in the ovary. Another adult specimen showed the testes as solid capsular masses in which there was a stroma-like matrix containing small blood-channels and groups of sperm-elements. In the ovarial chambers were present a great number of ova.

Female organs.—The ovaries are a pair of asymmetrical sacs extending backwards from the genital aperture in the median lacuna, ventral to the digestive tube. The vagina, which is the most anterior part of the female apparatus common to both sacs, appears to be filled with a mass of connective tissue previous to the laying of the eggs. It extends as far as the first pair of crop-cæca, lying in the ventral lacuna which, in this region, is narrow and bounded laterally by groups of strongly developed dorsi-ventral muscles which extend down the sides of the proboscis-sac. Opposite the point of origin of the first pair of crop-cæca the vagina passes into the anterior part of the ovaries. Here

the ventral lacuna becomes much wider owing to the disappearance of the dorsi-ventral muscles.

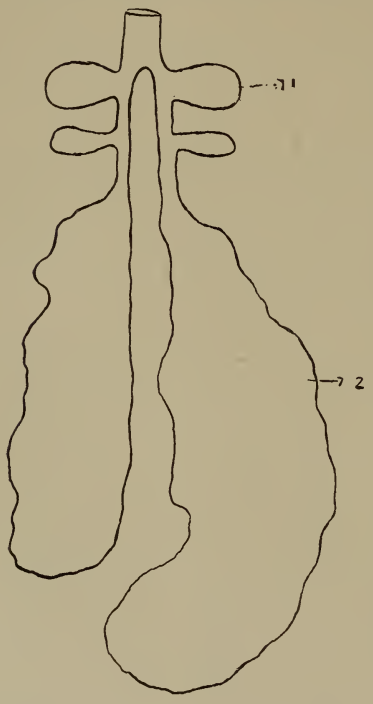

Fig. 4.—*Glossiphonia australiensis*, sp. n. Diagram of female organs.

The ovaries are large hollow sacs lying in certain regions in the large ventral lacuna, in other regions in the lateral portions of this lacuna according as the dorsi-ventral muscles are absent or present. Each ovary consists of three pouches, the first pair of which arises at its anterior extremity. These pouches are compressed antero-posteriorly, and appear oblong in transverse sections. They lie in lateral horns of the ventral sinus. The second pair of pouches lies in the median sinus itself, and resembles the anterior pair except that the pouches are smaller. The third pair of pouches constitutes the main portion of the ovaries. Whereas in the first and second pairs the wall is quite regular in outline, in the third pair the wall is much folded and irregular in outline. They arise at the point at which the proboscis passes into the œsophagus, and extend as far as the stomach. The ventral lacuna is here enormously developed, the dorsi-ventral measurement representing fully one-half the thickness of the section. The ovaries in this region, when the ova are stained with hæmatoxylin, form the most imposing structures in the body. The right ovary extends for some distance beyond that on the left side. They do not lie symmetrically, the right ovary

at intervals passing across partly into the left portion of the lacuna, and vice versâ.

That the pouches represent permanent structures, and not mere temporary dilatations due to the pressure of a large number

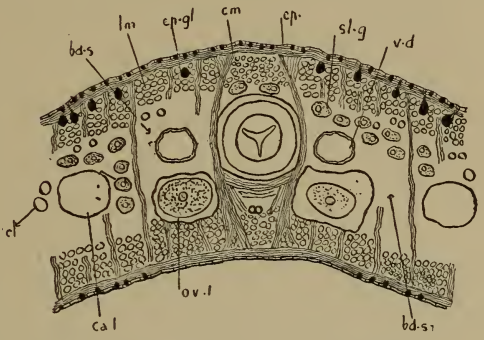

Fig. 5.—*Glossiphonia australiensis*, sp.n.
Transverse section passing through the first pair of ovarial pouches. Compare (3) fig. 7 and (1) fig. 4. (References as in fig. 6).

of eggs during the seasons of the year, is proved by the regular shape and symmetrical development of the first two pouches; and also by the way in which they lie in the ventral sinus, sometimes being cut off from the main portion of that cavity by the dorsi-ventral muscles.

Male organs.—The testes are arranged in six pairs.

In their early condition and during a season, as already mentioned, they are solid spherical organs containing abundant blood-supply. They lie immediately external to the ventral lacuna and imbedded in the body-tissue, and about half-way between the dorsal and ventral surfaces. Later they appear as crescentic hollow chambers containing abundant groups of sperms, the concave side of the testes facing towards the lacuna and crop.

The first pair lie immediately anterior to the point of origin of the first pair of crop-cæca. The others occur between the

successive cæca, the sixth pair lying in front of the last pair of crop-cæca.

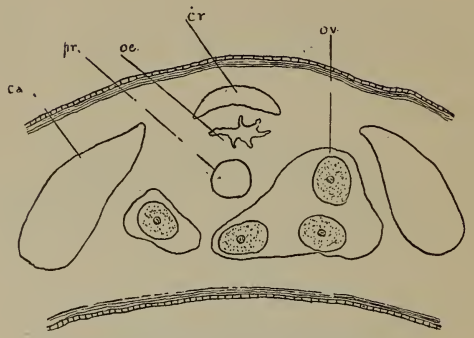

Fig. 6.—*Glossiphonia australiensis*, sp.n.

Transverse section passing through the crop, œsophagus, and retracted proboscis; and through the terminal portion of the ovary.

bd. s., body substance—*ca.*, crop cæcum—*ca. 1*, one of first pair of crop cæca—*cl.*, cœlomic sinus—*cr.*, crop—*cm.*, dermis+circular muscle—*ej.d.*, terminal horns of ejaculatory ducts—*ep.*, epidermis—*ep. gl.*, deep epidermal glands—*l.m.*, longitudinal muscle—*m.p.*, male genital aperture—*oe.*, œsophagus—*ov. 1*, first pair of ovarial pouches—*ov.*, terminal portion of ovary—*pr.*, proboscis—*pr. s.*, proboscis sac—*sl. g.*, salivary glands—*v.d.*, vas deferens.

In the species of *Glossiphonia* in general, the male genital ducts consist of a number of vasa efferentia which lead into a

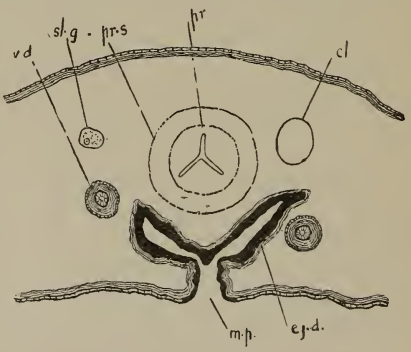

Fig. 7.—*Glossiphonia australiensis*, sp.n.

Transverse section passing through the male genital aperture. (References as in fig. 6).

main collecting tube, or vas deferens, in each side of the body.

The vasa deferentia wind about in the ventral lacuna, and eventually pass into the seminal vesicles, which grade into the ejaculatory ducts each of which expands terminally into a thick-walled "horn" which, uniting with the terminal "horn" of the other side, opens to the outside by the male genital aperture. The junction of the terminal "horn" and ejaculatory duct, Whitman has shown to be the formation and extrusion of the spermatophore.

In *Glossiphonia australiensis* there are some points of difference from other species. The "horn" and the ejaculatory portions of the vasa deferentia are exceedingly thick and muscular. From the male genital aperture there is a narrow passage leading vertically to the junction of the two terminal horns. Each horn is spindle-shaped, and directed obliquely upwards, outwards, and forwards to lead into the ejaculatory duct. This duct turns towards the ventral side, and runs back in that position as far as the level of the male aperture, where it turns sharply towards the dorsal side. It now runs for some distance between groups of dorsi-ventral muscles in a space which represents a cornual and anterior prolongation of the median lacuna; on a level with the lumen of the proboscis.

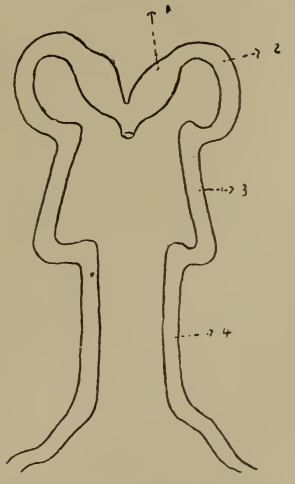

Fig. 8.—*Glossiphonia australiensis*, sp.n. Diagram of male reproductive ducts.

On reaching the region of the first ovarial pouches it turns sharply again to the dorsal side, and runs immediately dorsal and parallel to the pouch on each side of the body in the large lacuna which is here crescentic in shape, and surrounds the proboscis laterally and ventrally. In the region of the first pair of testes it turns sharply so as to run obliquely downwards and

outwards to the testes. From here no further traces of the male ducts can be found. Unlike other species of *Glossiphonia* there are no winding vasa deferentia in the median lacuna, and there appears to be a connection between the genital ducts and the digestive tube.

Nervous system.—As in all species of *Glossiphonia* there are twenty-one ganglia in the ventral nerve-chain. In connection with the constitution of the brain, I have been able to make out, from the study of the nerve-capsules, that the brain is composed of six fused ganglia. Oka has stated that he finds in the brain of *Glossiphonia* always thirty capsules, and he comes to the conclusion that it represents five fused ganglia. My conclusions are in accord with those of Whitman and Castle. As Castle has pointed out, Oka has possibly overlooked altogether the capsules of somite i., which lie anterior to the supra-œsophageal commissure. The posterior ganglionic mass represents seven fused ganglia.

Owing to the excellent work of Whitman, Castle, and Oka on the metameric constitution and ganglionic structure I cannot add anything of special interest in connection with the structure of the nervous system.

From the study of the nervous system it is seen that the body consists of thirty-four metameres, twenty-one of which are represented by the distinct ganglia of the ventral nerve-cord.

Nephridia.—These are very much reduced and inconspicuous structures. No traces of the nephridial funnels have been seen in section, and no well marked nephridiopores. The exact number of nephridia I have been unable to determine; and I can find no mention of the number in connection with the closely allied species, *Glossiphonia heteroclita*.

Castle mentions in his account of the Fresh-water Rhynchobdellids of North America the number of nephridia in all the species except in *G. heteroclita*. Unfortunately I am not in possession of specimens of this species, and so cannot at present make any comparative remarks.

Oka and Bourne have written a good deal in connection with the nephridia in general, and I find in this species differences

quite marked from others. I hope later to deal at further length with the nephridia when I have obtained other species for comparison.

As far as I can make out at present, the nephridia in this species are evidently disappearing; and in this feature, coupled with the fact that the so-called "excretophore" cells are very large and exceedingly abundant in the organism, lends some special interest to the question.

Blood-system.—The blood-system of *Glossiphonia* has been so thoroughly worked out by Oka, that very little can now be added to our knowledge of that system. In general arrangement the system in this species agrees very closely with that in other species of the same genus. One conspicuous feature is the very well developed channels in connection with the diverticula of the stomach. As already stated, the intimate relation of these vessels with the diverticula of the stomach seems to point to the conclusion that the stomach functions in connection with digestion and absorption.

Glossiphonia inflexa, sp.nov.

A single specimen of this species was obtained by Mr. H. L. Kesteven near Waverley, Sydney.

The body is broad and flat, and of a pale sage-green colour. It is semitranslucent. The marginal portion of the body is very thin, and in the preserved specimen folded under the ventral surface.

The length in an unextended condition is 14 mm., the breadth 4·5 mm.

The surface is very smooth, and the annulations are not very distinct, except near the margins of the body, and at the anterior extremity. The total number of annuli is seventy.

No eyes are present, and sense papillæ are present only in the middle body-region, where they occur on every third annulus.

The anus is situated on the dorsal surface of the last annulus, and has a much folded contour.

The genital apertures are united, the common pore being on the twenty-eighth annulus immediately behind a clitellar swelling

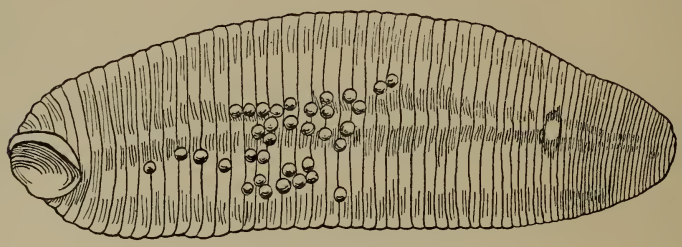

Fig. 9.—*Glossiphonia inflexa*, sp.n.
Ventral view showing the clitellum, and the reproductive aperture immediately behind it.

which extends from the anterior border of the twenty-seventh to the middle of the twenty-eighth annulus.

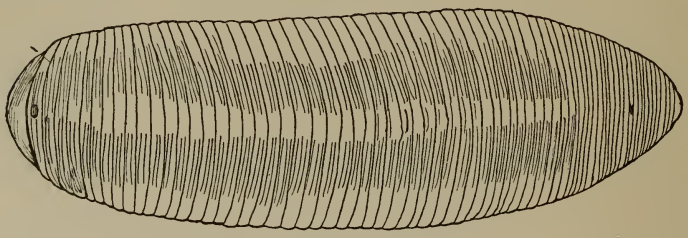

Fig. 10.—*Glossiphonia inflexa*, sp.n. Dorsal view.

Attached to the ventral surface were thirty-five eggs arranged singly.

Semilageneta, gen.nov.

Body thick, pear-shaped; dorsal surface convex, ventral surface flat. Somites denoted partly by papillæ, partly by sulci. Somites triannulate in the greater part of the body, and twenty in number, as seen on external examination.

Semilageneta hilli, sp.nov.

This leech was obtained in freshwater near Oberon, N.S.W., by Dr. J. P. Hill.

In the extended condition it is pear-shaped in outline, with a convex dorsal, and flat ventral surface. The greater portion of the ventral and dorsal surfaces are marked with grooves which divide the body into areas corresponding to the somites, as is found on more detailed examination.

The colour is a pale green.

The anterior portion of the body possesses numerous sets of sense papillæ.

The first somite is uniannulate, the second biannulate, and the remaining somites triannulate.

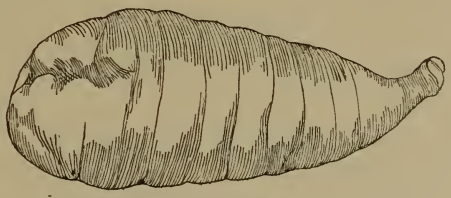

Fig. 11.—*Semilageneta Hilli*, gen.et sp.n.
Dorsal view. (Drawn from a photograph).

The head is constituted by eight annuli, the ninth annulus forming the posterior margin of the anterior sucker. Around the margin of the sucker, and on each of the annuli composing it are papillæ which are much larger than the other sensory papillæ, and probably represent goblet organs.

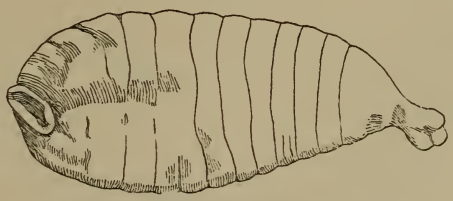

Fig. 12.—*Semilageneta Hilli*, gen. et sp. n.
Ventral view. (Drawn from a photograph).

The sense papillæ occur on the first annulus of each somite, as Whitman found to be the case in the leeches he examined. Castle, however, in his careful work on American Rhynchobdellids, came to the conclusion that the papillæ denoted not the

first but the middle annulus of a somite as far as the species of *Glossiphonia* are concerned. That this is not the case in the genus here described can be seen by glancing at fig.13.

The first somite is uniannulate, and has on its dorsal surface six papillæ. The second somite is biannulate, and has six papillæ on the first annulus. The two papillæ nearest the mid-line are much larger than the lateral pairs. The remaining somites are triannulate. In the third and fourth somites the sense papillæ are similar to those of the second somite. The papillæ are similarly arranged on somites v.-xi. inclusive, but are all of the same size and much smaller than on the preceding somites. Behind the eleventh somite the papillæ disappear; and the somites are distinctly marked off by definite sulci, producing a lobed margin, as can be seen in figs.11-12. Nine such somites can be made out behind the eleventh in dorsal view. The sulci do not reach the mid-line, and along that region is a well marked ridge. The nineteenth somite is wedged in between the eighteenth and twentieth in a peculiar fashion.

The total number of annuli is sixty-eight, sixty lying behind the posterior margin of the oral sucker. The annuli of somites eleven to eighteen inclusive are much larger than those of the remaining portion of the body, and increase gradually in size as they pass backwards from the eleventh somite. The annuli of the first eleven somites are very distinctly marked off from one another, the division in the case of the others being denoted by a fine line. The arrangement of the papillæ indicates that the somites in the greater part of the body are triannulate. This is corroborated by the arrangement of the ganglia in the ventral nerve-cord. In making an incision in the organism preparatory to imbedding in paraffin, I exposed portion of the nerve-cord and found that three ganglia thus seen each supplied three annuli.

If, as Castle found in species of *Glossiphonia*, the sense papillæ occurred not on the first annulus of a somite but on the middle one, it would be found that the first somite would be uniannulate, the second uniannulate, and the third triannulate; or the second biannulate, and the third biannulate, the remaining somites being

triannulate. This arrangement would leave the last annulus of the somite, which I have labelled xi. (fig. 13) unaccounted for,

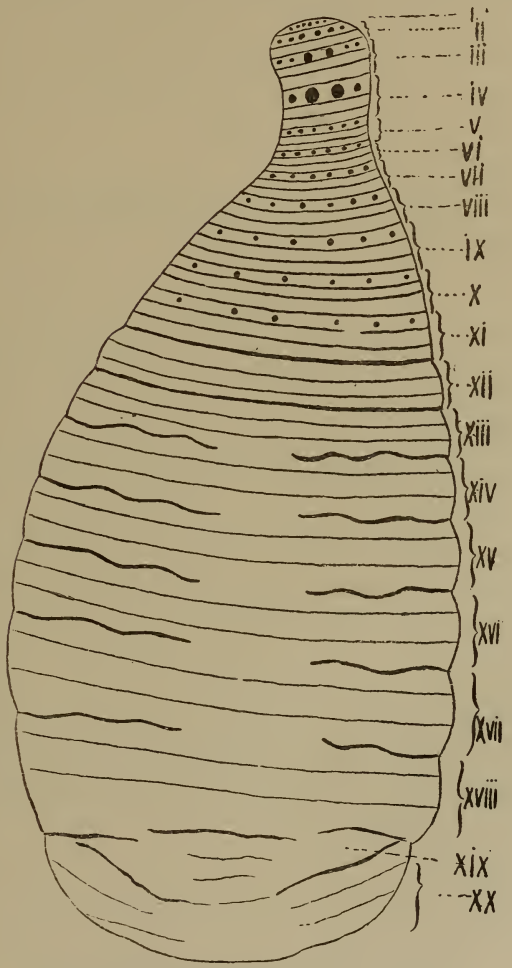

Fig. 13.—*Semilageneta Hilli*, gen. et sp.n.
Diagram showing the metameric arrangement in the annuli.

inasmuch as the sulcus behind this annulus certainly marks the line of division between somites xi. and xii. This important

point of difference between *Glossiphonia* and *Semilageneta*, as regards the metameric significance of the papillæ, is rather astounding inasmuch as they are members of one family.

Another point of interest in connection with *Semilageneta* is the great reduction of somites which are generally visible as part of the body. Here we find fourteen, instead of seven, somites represented in the acetabular region.

No eyes are present.

The genital apertures are apparently united, the common pore lying on the posterior portion of the twenty-first annulus, that is the last annulus of the eighth somite.

LITERATURE.

'88. Apathy, S. – Susswasser-Hirudineen. Ein Systematischer Essay. *Zool. Jahrb., Abth. f. Syst.* Bd. iii.

'04. Benham, W. B.—On a new Species of Leech. *Trans. New Zealand Inst.* xxxvi.

'06. ———On two new Species of Leech in New Zealand. *Op. cit.* xxxix.

'96. Blanchard—Leeches from Argentine and Paraguay. *Boll. Mus. Zool. ed Anat. Comp. di Torino* xi., No.263.

'97. ———Zoologische Ergebnisse—Einer Reise in Niederländisch Ost-Indien. Bd.iv.

'84. Bourne, A. G.—Contribution to the Anatomy of the Hirudinea. *Quart. Journ. Micros. Sci.* Vol. xxiv.

'49. Budge, J.—Clepsine bioculata, Sav. *Verh. d. Naturh. Vereins Preuss. Rheinlande.* Bd. vi.

'00. Castle, W. E.—The Metamerism of the Hirudinea. *Proc. Amer. Acad. Arts and Sci.* Vol.xxxv.

'00. ———Some North American Freshwater Rhynchobdellidæ, &c. *Bull. Mus. Comp. Zool. at Harvard Coll.* Vol. xxxvi., No.2.

'01. Dendy and Olliver – On a New Zealand Freshwater Leech. *Trans. New Zealand Inst.* xxxiii.

'71. Grube – Beschreibungen einiger Egel-Arten. *Archiv für Naturgeschichte.*

'98. Moore, J. P.—The Leeches of the U.S. National Mus. *Proc. U.S. Nat. Mus.* Vol. xxi.

'46. Moquin-Tandon, A.—Monographie de la Famille des Hirudinées. Paris.

'94. Oka, A.—Beiträge zur Anatomie der Clepsine. *Zeit. f. Wiss. Zool.* Bd. lviii.

'86. Whitman, C. O.—The Leeches of Japan. *Quart. Journ. Microscop. Sci.* Vol. xxiv.